

## §20. Deuterium Retention and Desorption Behavior of Boron-titanium after Deuterium and Helium Ion Irradiations

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Titanium flash and boronization have been often employed for controls of fuel hydrogen recycling and oxygen impurity level in fusion devices. The hydrogen retention behavior may be changed when titanium is mixed into boron, i.e. boron-titanium (B-Ti) is produced on the wall. The fuel hydrogen behavior for B-Ti little investigated so far. In this study, deuterium ion irradiation experiments were conducted for B-Ti prepared, and then the deuterium retention and desorption behavior was examined. This result was compared with B, Ti and crystallized  $TiB_2$ .

B-Ti film was prepared by electron beam evaporations of titanium followed by boron. B-Ti was irradiated by 1.7keV deuterium ions and an amount of retained deuterium and desorption temperatures were measured. For comparison, similar experiments were conducted for boron (B) and titanium (Ti) films similarly prepared and hot pressed  $TiB_2$ . The amount of retained deuterium in B-Ti was approximately 1/3 or 1/2 of that in Ti or B, respectively. Desorption peaks of deuterium in B-Ti were 470 and 620K, corresponding to desorption observed in B in the low temperature regime and desorption in Ti, respectively. An average desorption peak in B-Ti was 590K, which is lower than that in B (660K) and in Ti (650K).

The amount of retained deuterium in B-Ti was compared with that in  $TiB_2$ . As shown in Fig. 1, the amount of retained deuterium in B-Ti was comparable with that in  $TiB_2$ . However, the desorption temperature in  $TiB_2$  was 730K, higher than that in B-Ti

This difference was discussed based upon chemical binding and crystal structures of B-Ti. As shown in Fig. 2, the binding state of B in  $TiB_2$  is of  $TiB_2$ , but the binding states of B in Ti-B were partly  $TiB_2$  and B-B. This result suggests that the boron in B-Ti is amorphous, so that B-D-B bond is easily produced. The deuterium desorption temperature from B-D-B bond is 470K. This is the reason why the deuterium in B-Ti desorbs at low temperature regime.

Helium ion irradiation was conducted for B-Ti after the deuterium ion irradiation. The amount of retained deuterium decreased and the average desorption peak shifted to a lower temperature regime, as increase of helium ion fluence. The shift to

the low temperature regime is due to enhancement of amorphous structure in B-Ti.

The present results show that use of amorphous B-Ti can reduce fuel hydrogen retention in first walls and improve fuel hydrogen recycling.

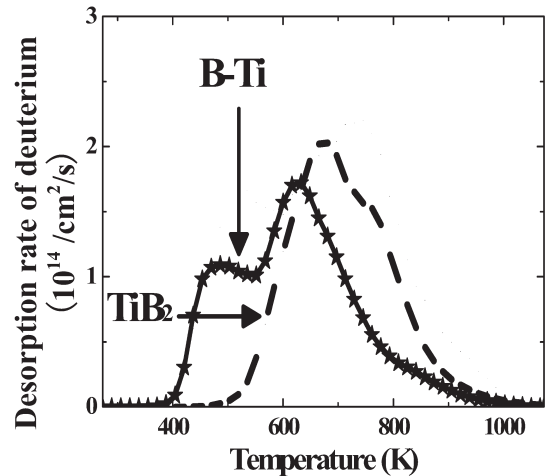


Fig. 1 Deuterium desorption spectra of  $TiB_2$  and B-Ti.

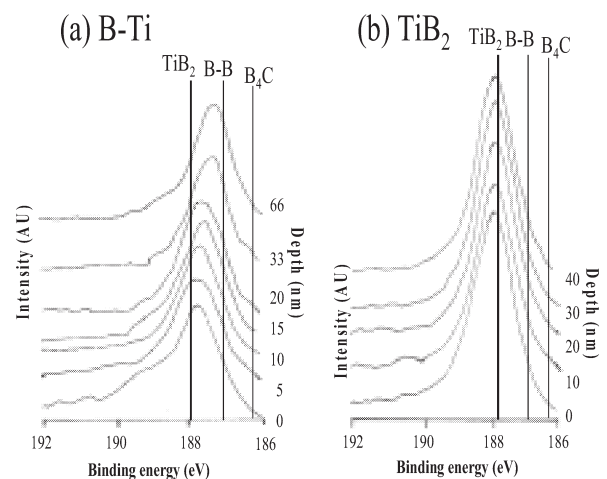


Fig.2 XPS spectra of B in  $TiB_2$  and B-Ti.

### Reference

- 1) T. Hino et al. Submitted to Nuclear Fusion, (2007)